

ANTI-ESD MOVABLE RACK SYSTEM FOR STORING RETICLES

BACKGROUND OF THE INVENTION

Field of the invention

[0001] The present invention relates in general to semiconductor manufacturing industry, and more specifically to movable racks for storing reticles. Even more specifically, the invention relates to reticle storing movable rack system having anti-electrostatic-damage and earthquake-proof properties.

Description of the related art

[0002] It is well known in the art that in the fabrication of semiconductor devices and integrated circuits, electrostatic discharge is a phenomenon that commonly occurs during the handling of semiconductor integrated circuit devices and one of the main factors causing damage of the integrated circuits that may turn into a very critical problem immediately affecting stable yield and smooth production.

[0003] As an example, the static electricity problem may arise when an operator walks on a carpet with semi-conductor wafers. Electrostatic voltage of about a few hundred volts may exist on one's body and wafers if relative humidity is high. With humidity being at its low, the electrostatic

voltage may reach as high as about a few thousand volts. If a conductive object occasionally contacts the wafers, a substantial electrostatic damage could occur and damage the integrated circuits on the wafers. Electrostatic damage is an especially serious problem for fabrication of a complementary metal-oxide semiconductor device.

[0004] Damage due to electrostatic charge, which may accumulate for various reasons and produce potentially destructive effects on an integrated circuit device, typically can occur during a testing phase of the fabrication of the integrated circuits or during assembly of the integrated circuit onto a circuit board, as well as during use of equipment, into which the integrated circuit has been installed. Damage to a single integrated circuit due to poor electrostatic damage protection in an electronic device can partially, or sometimes completely, hamper its functionality. Electrostatic damage protection for semiconductor integrated circuits is, therefore, a reliability issue.

[0005] In semiconductor industry, the above-identified problem of electrostatic damage and protection there against may exist with regard to various articles. Those may include silicon wafers, reticles, or other substrates used for building integrated circuit devices. (By reticle, a transparent ceramic substrate is understood that is coated with a metallic layer forming a pattern for an electronic circuit. The reticle is generally used in an imaging step during a photolithographic process where a pattern of a circuit is reproduced on the surface of an electronic substrate, i.e., on a wafer surface.) In a semiconductor fabrication facility, static electricity or electrostatic discharge

frequently develops on surfaces of articles made of insulating materials when they are touched or rubbed by other insulating materials such as insulating gloves. The electricity is produced based on a triboelectricity theory. The discharge of the static electricity to machines and to human operators can cause damage not only to semiconductor wafers but to process tools as well. Sometimes, it may even cause injury to a machine operator.

[0006] In semiconductor industry, specifically in manufacturing integral circuits, idle reticles, i.e. those not involved in a current manufacturing process, are usually stored on racks. Reticles on the racks are subjected to electrostatic damage. Capacity of existing racks is not sufficient enough. Also, there is high risk of them being damaged in case of earthquake. Therefore, a need exists to provide racks for storing reticles that would be free of drawbacks of existing structures used for the same purpose.

[0007] On the other hand, known in the art are various structures of sliding storage racks that seemingly could be used for storing reticles. For example, Potter, U.S. Patent No. 3,601,257, discloses a file apparatus having movable racks. The apparatus has parallel tracks, between which rollers movable along the tracks suspend racks supporting looseleaf binders. The rack is tubular and has an open-ended channel, in which a T-bar is disposed. A plate stem depending from the T-bar through a slot lengthwise of the bottom of the rack carries a binder. The T-bar is slidably inserted or removed through an end of the channel as a unit with the binder. A nameplate clipped to an end

of the rack identifies the contents of the binder. A cutaway at each end of the rack allows easy insertion or removal of the T-bar. The apparatus may be formed to carry tracks extending in a longitudinal as well as in a lateral direction, permitting selective use of either set of tracks to support the racks. The apparatus may also be formed of groups of posts supporting tracks at various levels between them. The latter construction is extensible to include additional levels of tracks; and is of a knockdown nature permitting ready assembly or disassembly of its component parts.

[0008] In another U.S. Patent (No. Re. 35,047), Potter disclosed a self-sliding storage rack for 3480 cartridges. In accordance with the invention, cartridge storage racks are arranged end-to-end and back-to-back in stationary rows. Additionally, adapted to be mounted to slide alongside the front of each row are similar racks. The number of stationary racks, without disturbing existing racks, may be extended to the extent of room space; and track elements may be added as needed to the extent of the rows of stationary racks for sliding additional slide racks. The slide racks slide relative to the stationary racks in such manner as not to block full access of an individual to the stationary racks; and means is provided to brake the sliding racks against over-travel relative to the stationary racks.

[0009] Latino, U.S. Patent No. 5,341,944, discloses a modular library system for computer cartridges has stationary and mobile racks. Each of the racks comprises a plurality of spaced "T" shaped vertical supports. The vertical supports define vertical spaces for receiving cartridge holding

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trays or packs. The "T" shaped supports have tabs for holding the packs. A top panel, a rear panel, a mounting base, and a spreader interconnect the "T" shaped supports. The spreader interlinks with all the vertical supports for providing structural rigidity.

[0010] Croker, U.S. Patent No. 5,439,281 discloses a movable storage system that has one or more storage units, a plurality of flexible track elements conformable with an irregular supporting surface, and an individual base structure, which supports each storage unit for movement along the track elements through roller members associated with particular track elements. The flexible track elements have a pair of cylindrical longitudinally extending track members supported by a flexible base. The roller members or wheels have a generally U-shaped external contour, which encompasses the track elements and prevents derailing of the storage units.

[0011] Theken, U.S. Patent No. 5,624,166, discloses a mobile storage cabinets, which are "slide-by" cabinets, that is, the cabinets ride on a carriage in a longitudinal direction on a cabinet track to allow access to the contents of a posterior cabinet. The top surface of the posterior cabinet includes an anti-tip track, which is substantially parallel to the cabinet track. The anti-tip track has a cylindrical groove with a longitudinally extending top opening, which forms a slot. A football-shaped is captured in the groove to form a journaled follower, which optionally includes roller bearing surfaces, vertical link extends through the slot and is joined at a fixed angle to a horizontal link,

which is pivotally joined to a bracket member attached to the back surface of a front cabinet. The bracket extends beyond the top of the cabinet. If multiple rows of cabinets are used, the anti-tip assemblies for the cabinets of each row are stepped so that they clear the top of posterior cabinets.

[0012] Sarno, U.S. Patent No. 5,683,155, discloses an apparatus for moving laterally accessible file storage or similar shelving units, from a stowed densely packed lateral array of such units, longitudinally to a full access position. The apparatus includes a wheeled carriage, which travels over a flat supporting track laid in the path of the carriage as the unit is rolled longitudinally. The flexible track has a leveling feature, which can accommodate uneven or varying level base floor surfaces. Return movement of the carriage picks up the flexible track leaving no exposed portion of the apparatus when the unit is stowed.

[0013] Baker et al., U.S. Patent No. 6,112,917, discloses a large capacity mobile storage system having a plurality of storage units and a plurality of interconnected support assemblies for rolling movement. Each of the support assemblies includes a frame and a pair of spherical shaped hardened steel support wheels. Only one of the support assemblies includes a pair of guide rollers disposed perpendicular to its associated support wheels in order to maintain rolling movement of the storage system along a linear path. The support wheels of the other support assemblies are allowed to move independently from one another in order to prevent the scrubbing action of the supporting apparatus. The supporting assemblies also include a drive track and a sprocket disposed at one end of the

storage unit with a drive mechanism. This feature helps to keep the floor area between the flat tracks uncluttered. The apparatus compensates for a significant degree of unevenness and undulation of the flat tracks caused by an uneven floor upon which the flat tracks are mounted.

[0014] Baker et al., U.S. Patent No. 6,158,601, discloses a modular storage apparatus for movably supporting one or more storage units in front of a plurality of non-movably supported storage units. The apparatus comprises a plurality of independent, modular base sections each having a pair of tracks thereon, which are securable together via cam lock coupling devices to form a single, rigid, lightweight, elongated base assembly. A leveling and supporting system associated with each base unit enables the entire base assembly to be precisely leveled. The base units each support at least one carriage unit, which in turn supports an independent storage unit thereon. An anti-tip system prevents each movable storage unit from tipping or leaning beyond a predetermined degree. The modular construction enables the apparatus to be easily and conveniently shipped, packaged and handled and the assembled base assembly does not need to be secured to a supporting floor.

[0015] All the advantages of the above-described devices notwithstanding, neither of them seems to be adapted for storing reticles. They do not address the problem of electrostatic damage protection. Neither of them deals with earthquake protection. The above-described prior art references do not disclose any suggestion as to the way of modifying the respective structures to solve those problems.

[0016] Therefore, the primary object of the present invention is to provide a movable rack system that, while keeping advantages of the racks known in the art, would at the same time be suitable for a specific purpose – to store reticles.

[0017] Another object of the present invention is to provide a movable rack system for storing reticles that would secure the reticles against electrostatic damage.

[0018] Yet another object of the present invention is to provide a movable rack system suitable for storing reticles that, along with the ESD protection, would protect reticles against from falling out of the racks during a moderate earthquake.

SUMMARY OF THE INVENTION

[0019] Providing a movable rack system attains the above-identified objects of the invention. According to the present invention, a reticle storing movable rack system comprises a plurality of flat tracks fixedly secured to a floor. There is provided a plurality of rows of storage units. Each row has a plurality of independent racks interconnected with each other, which racks are adapted to be moved as a single row along the flat tracks. Provided also is a user engageable drive assist mechanism to move the rows. Each of the racks comprises shelves with plurality of cells for housing reticles therein. The racks are electrically grounded, and the cells have electrostatic shielding properties.

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[0020] Making the cells metallic and electrically connecting them to the racks secure the electrostatic shielding properties.

[0021] With the purpose of imparting antiseismic properties to the system, the shelves are made with a slope directed inside the racks.

[0022] The slope is selected to be preferably about 8° .

[0023] To further increase capacity of the system, the rows can be made double-sided.

BRIEF DESCRIPTION OF DRAWINGS

[0024] The above-mentioned and other objects, advantages and features of the present invention will be in more detail illustrated in and will become more apparent to those skilled in the art from the ensuing specification and subjoined claims, when considered in conjunction with the accompanying drawings, in which:

[0025] Figure 1a is a side view of a row of storage units of the system according to the present invention;

[0026] Figure 1b is a front view of a row of storage units of the system according to the present invention; and

[0027] Figure 2 is a photo fragment of a plurality of rows of a pilot model of the system according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Referring now to Figures 1a, 1b, and 2, a movable rack system 10 for storing reticles comprises a plurality of rows of storage units 12. Each row consists of plurality of independent racks 14 interconnected to each other in such a way that they are adapted to be moved as a single row to permit access between any pair of adjacent rows of storage units 12. The racks 14 comprise shelves 16 carrying cells 18. Each of the cells 18 houses a reticle in a box (not visible in the Figures).

[0029] There also provided flat tracks 20 fixedly secured to a floor 22, whereas the racks 14 are equipped with wheels 24, and the racks 14 are made movable along the tracks 20. A drive assist mechanism enables an operator to easily move its associated rack row in a storage unit 12 along the tracks 20 by providing a mechanical advantage through a suitable arrangement of gears. Each drive assist mechanism includes a hand assembly 26, which the operator turns rotationally to impart linear

movement to its associated storage unit 12 via a drive chain (not shown). Drive assist mechanism of this kind are well known in the art and therefore are not discussed in more detail.

[0030] To cope with the electrostatic damage problem, a number of measures are to be taken according to the present invention. Walls and floor coverings are built with slightly conductive materials such that electrical charges can be routed to ground. The coverings are connected to the metal framework of the wall systems, which is connected to the planar ground (not shown in the Figures). The racks 14 and tracks 20 are made of metal. The tracks 20 are grounded that is symbolically shown by reference numeral 28. Therefore, an electrical connection is established between the racks 14 and the grounding 28. Besides grounding the racks 14 through the tracks 20 and floor 22, they can be additionally grounded through electrically connecting them to overhead joists (not shown), which in turn are electrically connected to the walls.

[0031] According to the present invention, the cells 18 exhibit electrostatic shielding properties. They are made of metal, for example light steel, and electrically connected to the racks 14. The connection can be carried out by electrically joining the cells to the rack through the shelves provided the latter are also metallic, or directly, not relying on the shelves.

[0032] To additionally contribute to anti-electrostatic-damage protection, an operator can also be grounded since the body constitutes an electric charge.

[0033] The above-discussed anti-electrostatic-damage measures and features lead to impressive results. Whereas the number of electrostatically damaged reticles after 24, 48, and 72 hours of being stored in the prior art system was 7, 13, and 17, respectively, none of reticles was electrostatically damaged after 24, 48, and 72 hours of being stored in the system according to the present invention.

[0034] To conveniently increase capacity of the system, the rows of racks 14 can be made double-sided, that is arranged back-to-back as shown by 14a and 14b in Figure 1. Calculations show that making the racks double-sided and movable can increase the capacity of the idle mask storage up to 250% (say, from 6000 reticles up to 15,000 reticles).

[0035] Though it is believed that the above-described system is relatively stable due to its structure and thus can hold out against a non-catastrophic earthquake, the present invention adds to the system's earthquake-proof features. According to the invention, the shelves 16 are made slant, with a slope directed inside the rack 14, toward its back that is shown in Figure 1a by dotted double lines and can also be visible in Figure 2 by an angle between a stanchion 30 and edges 32 of the otherwise rectangular cells 18 placed on the shelves 16. Preferably, the angle is selected to be about 8°. Making the shelves with the slope prevents the boxes with the reticles from falling down out of the cells in the time of earthquake.

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[0036] While the preferred embodiment of the present invention has been disclosed herein above, it is to be understood that this embodiment is given by example only and not in a limiting sense. Those skilled in the art may make various modifications and additions to the preferred embodiment chosen to illustrate the invention without departing from the spirit and scope of the present contribution to the art. Accordingly, it is to be realized that the patent protection sought and to be afforded hereby shall be deemed to extend to the subject matter claimed and all equivalence thereof fairly within the scope of the invention.